TECHNICAL MEMORANDUM
EVALUATION OF USE/DISPOSAL OPTIONS FOR TREATED WATER FROM BETHPAGE WATER DISTRICT (BWD) WELL 6-2

1.0 INTRODUCTION

This technical memorandum has been prepared to develop and evaluate options for maximizing the use of Bethpage Water District (BWD) Well 6-2 to serve as both a public water supply and remediation well. This technical memorandum also evaluates potential options for the use or disposal of treated water from the sustained operation of BWD Well 6-2. As discussed below, the dual use of this well would provide substantial environmental benefit for the area, could be implemented quickly, would be very cost effective, and technical issues were not identified. BWD has been operating this well and treating the groundwater for decades, and has consistently achieved all applicable requirements.

The Navy is addressing volatile organic compounds (VOC)-impacted groundwater associated with Northrop Grumman's (NG's) operations at the former Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage under the 2003 Operable Unit 2 (OU2) Record of Decision (ROD). In the 2003 OU2 ROD, the Navy is tasked with identifying and remediating hotspots through its groundwater monitoring program. Hotspots are defined as groundwater with total VOCs greater than 1,000 micrograms per liter (ug/L). The GM-38 Hotspot Area was identified in the ROD and remediation of this hotspot is an ongoing operation. In addition, another hotspot (RE-108) was identified. It represents a relatively small portion of the off property groundwater plume but contains the majority of the off-property contaminant mass. Based on recent groundwater investigations, the RE-108 Hotspot is located downgradient (south) of the former NWIRP Bethpage and NG properties and north of Hempstead Turnpike (Figure 1). The RE-108 Hotspot is in the deeper portion of the aquifer at a depth of approximately 500 to 750 feet below ground surface (bgs). The plume consists primarily of trichloroethene (TCE) at concentrations greater than 1,000 ug/L and contains a calculated 41,000 pounds of TCE. The Navy is currently designing a groundwater extraction and treatment system for this Hotspot near Hempstead Turnpike, approximately 5,500 feet south of the former NG property. This system is anticipated to be in operation by 2023. BWD Plant 6 is located near the mid-point of the RE-108 Hotspot Area, approximately 2,500 feet north of Hempstead Turnpike.

The use of BWD Plant 6 as a remediation well was identified in the 2012 "Study of Alternatives for Management of Impacted Groundwater at Bethpage". In particular, the sustained pumping of BWD Well 6-2 was identified as a means of efficiently reducing migration of the off-site plume by removing VOC mass from the aquifer. The Navy also evaluated the installation of a groundwater recovery well and treatment system in the area of BWD Plant 6 to accelerate aquifer cleanup, but concluded that it would likely interfere with the operation of BWD Plant 6 and would not be cost effective to operate solely as remediation well. At that time, the RE-108 Hotspot (formerly known as the Plant 6 Hotspot) was believed to be limited to the area north and west of BWD Well 6-2, suggesting that BWD Well 6-2 could potentially be used to fully capture the Hotspot. Subsequent groundwater investigations in 2013 to 2016 found that the Hotspot was also to the south and southwest of BWD Well 6-2 and based on current evaluations, sustained operation of BWD Well 6-2 would not be expected to fully capture the Hotspot. This current evaluation is also what led the Navy to pursue the capture of the RE-108 Hotspot further south near Hempstead Turnpike. Regardless of the use of the more southern extraction wells, the sustained operation of BWD Well 6-2 would remain an important part of an overall program to manage the RE-108 Hotspot and could be used to capture up to 40 percent of the RE-108 Hotspot groundwater. Based on the mid-plume location of BWD Well 6-2, sustained groundwater extraction at this location would significantly accelerate cleanup of the Hotspot and the overall off property groundwater plume.

BWD operates two public water supply wells at Plant 6. BWD Well 6-1 is relatively shallow, VOC concentrations are relatively low, and it is not anticipated to intercept the Hotspot. As a result, it will not be discussed further in this memorandum. BWD Well 6-2 is screened at a depth of 700 to 770 feet bgs, has had sustained TCE concentrations of over 1,000 ug/L for several years, and therefore, has been demonstrated to intercept the Hotspot.

BWD has effectively treated this water and consistently achieved drinking water standards in these wells since the early 1990s. In addition, the system normally achieves non-detect values at 10 percent (1/10) of the drinking water standards. BWD Plant 6 currently uses air stripping and liquid phase granular activated carbon (GAC) polishing, which provides redundant treatment for VOCs. BWD is currently planning to modify the system to replace aging equipment, optimize operations, and provide offgas treatment using vapor phase GAC.

The approved capacity of the well is 2 million gallons per day (MGD) or 730 million gallons per year (MGYr). BWD currently operates that system on a limited basis that varies from year to year. From 2011 to 2013, BWD pumped 46 to 395 MGYr, with an average of 250 MGYr. At the average pumping rate and TCE concentration in the well at approximately 1,300 ug/L, the BWD Well 6-2 treatment system removes approximately 2,700 pounds of TCE per year from the aquifer. If BWD Well 6-2 operated at its full capacity, approximately 7,900 pounds of TCE per year could be removed from the aquifer. Since the source of the VOCs in the northern portion of the RE-108 Hotspot has been cutoff by the NG Onsite Containment System, the more mass that is removed by BWD Well 6-2, the less time that BWD Well 6-2 will experience elevated TCE concentrations, e.g., less than 10 years.

Although this technical memorandum focuses on BWD Plant 6, dual use could be considered for other well fields with treatment that could intercept VOC-impacted groundwater to reduce potential impacts to downgradient public water supplies, including South Farmingdale Water District (SFWD) Plant 3 and New York American Water (NYAW) - Seamans Neck Road (SNR).

2.0 HYDROGEOLOGY OVERVIEW

The groundwater in the area originates as precipitation. For the Bethpage area, the deepest groundwater originates in the northern portion of the area near the Long Island Expressway and flows south-southeast to the South Oyster Bay and the Atlantic Ocean. As the groundwater travels to the bay/ocean, additional precipitation falls, adds to the flow, and also pushes the upgradient groundwater downward. Near the bay/ocean the groundwater rises since its density is lighter than the bay/ocean salt water. Under natural conditions, all of the groundwater would flow to the bay/ocean. However, deep pumping wells for industry, commercial facilities, remediation, and public water supplies are extracting groundwater, which causes horizontal and vertical stresses on the aquifer and results in localized variations in the groundwater flow. Recharge basins that accept extracted waters also cause stresses on the aquifer and localized variations in flow. The natural and manmade flows are also influenced by a complex geology in the area that further disrupts localized flow. However, even with the current pumping rates, the majority of the groundwater flows into the bay/ocean, see Figures 1 and 2.

A portion of the groundwater in the Bethpage area is impacted by VOCs that form plumes and migrates with the groundwater. In addition, due to variable releases, precipitation, or pumping rates, the plume can fragment into individual fingers. Based on the groundwater monitoring program, less than 10 percent of the groundwater is impacted by VOCs. VOC-impacted groundwater that is not intercepted by public water supplies, will discharge to the bay/ocean. As a result of attenuation including volatilization, advection, and dilution, VOCs would not be expected to adversely impact aquatic organisms or use of these waters.

3.0 GROUNDWATER TREATMENT

To address the VOC-impacted groundwater, remediation systems are currently in operation in the Bethpage Area to contain and treat this groundwater. These remediation systems use air stripping and/or liquid phase GAC treatment to remove the VOCs prior to re-introducing the water back into the aquifer through recharge basins or dry wells. The treatment systems consistently achieve the Federal Safe Drinking Water Act and New York State Department of Health maximum contaminant levels (MCLs) in the discharge. In addition, these systems routinely achieve concentrations of 1/10 (10 percent) of the MCLs.

Public water supply systems and groundwater remediation systems contain many common features and have few differences. Public water supplies and remediation systems both extract groundwater from the same aquifer and use the same treatment equipment to remove VOCs. For example, BWD Plant 6 uses a combination of air stripping and GAC, while SFWD Plant 3 uses only air stripping, and NYAW-SNR uses only GAC. The GM-38 Hot Spot Treatment System uses a combination of air stripping and GAC. The treatment requirements for the public water supplies are the same as for the remediation systems – to achieve MCLs, and the treatment goal is typically 1/10 of MCLs.

The water from the public water supplies either ends up back in the aquifer, is lost through evaporation (e.g., lawn watering), or is discharged to the sanitary wastewater treatment system and ultimately into South Oyster Bay and the Atlantic Ocean. Whereas the water from the remediation systems is drawn into a downgradient public water supply and eventually discharges into the bay/ocean.

The primary difference between the treatment systems for remediation and public water supply systems is the use of sodium hypochlorite in the public water supply systems to control bacteria growth within the treatment and distribution systems. The State and County have rigorous treatment and monitoring programs in place to ensure the systems are sterile after construction and extended down times, as well as additional monitoring during routine operations. Bacterial control is not needed for the remediation systems because the water is discharged to open basins that also receive storm water that naturally contains bacteria.

Remediation and public water supply systems also operate differently. Remediation systems normally operate continuously (run times of over 95 percent), whereas the public water supply pumping/treatment systems operate based on hourly, daily, and seasonal demand by the customers (average annual run times of 20 to 50 percent). The public water supplies balance customer demand with system operation by using storage facilities (e.g., water towers), interconnections between different pumping wells, and on/off operation of the individual pumping wells and associated treatment systems.

This analysis does not specifically address potential future treatment requirements associated with emerging contaminants, such as 1,4-dioxane. 1,4-Dioxane is present in site groundwater, but not at concentrations exceeding current promulgated drinking water standards. Drinking water standards for 1,4-dioxane are under review and may be lowered in the future. Based on available data, the concentration of 1,4-dioxane in groundwater is not expected to be toxic to aquatic organisms or bioaccumulate. Discharge options that reuse the water or allow the water to infiltrate into the aquifer will generally be required to comply with drinking water standards. Common treatment processes for VOCs such as air stripping and GAC do not remove 1,4-dioxane from the water. However, no treatment should be required for 1,4-dioxane if it is discharged to surface waters that do not infiltrate back into the aquifer.

4.0 DISCHARGE OPTIONS

Discharge options for treated groundwater consist of recharge basins, dry wells /leach fields, injection wells, direct discharge to surface water, sanitary system, and public water supply. Each of these options, as well as effectiveness, implementability, and relative cost factors are discussed below.

4.1 RECHARGE BASINS

A recharge basin is a large deep depression that allows water to flow into the surrounding aquifer. Typical basins are one or more acres in areal extent and 20 to 40 feet deep. In the middle portions of Long Island where streams and rivers are generally absent, basins represent a common option for reliably handling high volumes of water with limited maintenance. Since recharged water would likely be extracted by a downgradient water supplier, the water is normally treated to achieve drinking water standards.

Effectiveness

Local recharge basins are highly effective at infiltrating high continuous volumes of treated groundwater. For example, at OU2 - GM-38 Hotspot Treatment System, 1.4 MGD of treated water is discharged in an approximate 1.1-acre basin. For the OU2 - ONCT, approximately 4 MGD of treated water are discharged to three basins totaling approximately 4 acres (south basins) and another 1.5 MGD is being discharged to two basins totaling approximately 1.2 acres (west basins). An evaluation by NG indicates that additional capacity is not available at these basins. Periodic scraping of the basins are required to maintain infiltration rates (e.g., 2 to 7 years). This option allows water to remain within the local aquifer.

Implementability

The use of existing local recharge basins should be implementable. The nearest recharge basin to BWD Plant 6 is likely the same basin used by the GM-38 Treatment System, located approximately 0.25 mile away. The availability of local storm sewers leading to this basin is uncertain, but if present, would reduce or eliminate tie-in requirements. This basin is also being targeted by NG for discharging water from the RW21 Treatment System. Additional excess capacity in this basin is uncertain, a detailed evaluation of basin capacity would be required. Other basins are located approximately 0.5 mile away, but may also have capacity restrictions.

Piping runs would be required through densely populated commercial and/or residential areas that would disrupt local activities. In the past, this type of disruption has not been well received by the public, and has significantly delayed similar construction projects (e.g., GM-38 and RW-21 Treatment Systems). There is very limited open space available to construct new recharge basins in the area; therefore, discharges would generally be limited to existing basins.

Cost

Costs for basin operation are generally low. Periodic work in the basin would be required to maintain infiltration rates. Based on which basin is selected, piping costs would be expected to total approximately $200,000 to $750,000. Routine monitoring costs, consisting primarily of monthly VOC analysis and reporting, would be approximately $50,000 per year.

4.2 DRY WELLS AND LEACH FIELDS

Dry wells and leach fields are engineered subsurface structures designed to allow groundwater to flow into the surrounding aquifer through the structure sidewall and/or bottoms. Typical dry well dimensions are 6 to 10 feet in diameter and 10 to 20 feet deep. Leach fields are normally constructed of horizontal perforated pipes in gravel trenches. Leach fields can also be a series of interconnected dry wells.

Dry wells are part of the design for the new public water supply treatment systems at BWD Plant 6. Discharge requirements would be the same as with recharge basins. Dry wells are also commonly used in the area for low to moderate volumes of water (e.g., parking lot and building roof drains). Dry wells and leach fields allow for limited use of the ground surface above them, e.g., parking or green space.

Effectiveness

Dry well and leach fields can be designed to infiltrate moderate to high volumes of treated groundwater. Dry wells require the same or more space than recharge basins, whereas leach fields typically require much larger areas. The dry wells and leach fields are difficult to clean and may require periodic replacement. Water quality requirements and issues would be the same as recharge basins. The use of dry wells for long term discharge of excess water from BWD Plant 6 is uncertain. This option allows water to remain within the local aquifer.

Implementability

Although dry wells and leach fields can likely be implemented, there is no apparent available space that can be used to install these units. The utility corridor located east of BWD Plant 6 may be considered for use. Piping runs would be required through densely populated commercial and/or residential areas that would disrupt local activities. In the past, this type of disruption has not been well received by the public, and has significantly delayed similar construction projects (e.g., GM-38 and RW-21 Treatment Systems). Existing local parking lots commonly use drains. Dry wells and leach fields would restrict potential future use of a property.

Cost

Costs for dry wells would be moderate to install and operate. Periodic (e.g., annual) cleaning may be required to maintain the discharge capacity. Based on finding a viable location, within one mile, construction costs would be expected to total approximately $1.0 million to $1.5 million. Routine monitoring costs, consisting primarily of monthly VOC analysis and reporting, would be approximately $50,000 per year.

4.3 INJECTION WELLS

Injection wells are large diameter pipes installed deep into the ground to allow water to flow into the surrounding aquifer through perforations. Typical dimensions are 12 inches in diameter and 150 feet deep. Injection wells can be used where space is limited. Discharge requirements would be the same as with recharge basins. Theoretically, two injections wells are required for each extraction well. In practice, three or more injection wells are installed to effectively hand the flowrates.

Effectiveness

Injection wells can theoretically provide high infiltration rates, but are subject to rapid fouling. During actual practice, injection wells are not very reliable in the long term and can interfere with long-term continuous operation. Injection wells can be redeveloped, but performance continues to deteriorate over time and would require periodic replacement. Well replacement can take several months to accomplish. Redevelopment generates high volumes of waste that would need to be managed. Water quality treatment requirements would be same as recharge basins. This option allows water to remain within the local aquifer.

Implementability

Injection wells can be installed in multiple areas, with relatively minimal surface disturbances. Piping runs would be required through densely populated commercial and/or residential areas that would disrupt local activities. In the past, this type of disruption has not been well received by the public, and has significantly delayed similar construction projects (e.g., GM-38 and RW-21 Treatment Systems).

Cost

Construction and maintenance costs for injection wells would be much higher than recharge basins and dry wells/leach fields. Based on finding a viable location, within one mile, construction costs would be expected to total approximately $3.0 million to $4.0 million. Routine monitoring costs, consisting primarily of monthly VOC analysis and reporting, would be approximately $50,000 per year.

4.4 DIRECT DISCHARGE TO SURFACE WATER

Direct discharge would consist of a combination of subsurface pipe/sewer line to transport treated water to a discharge point. A discharge structure would control entry into the surface water. Direct discharge may be considered primarily for those systems with anticipated long term operation.

Direct discharge to the South Oyster Bay, or surface water streams leading to the bay or ocean, are viable means of discharging large quantities of water. This option can reliably handle high volumes of water with limited maintenance. Direct discharge is limited primarily by the distance and potential construction restrictions between the extraction system and the discharge point. Although alternative surface water standards may be considered, extracted groundwater would likely be treated to achieve drinking water standards. Possible discharge options consist of Massapequa Creek, Seaford Creek, and Bellmore Creek. A final selection would be based on routing, potential recharge and impacts to public water supplies, and cost.

Effectiveness

Discharge to a surface water body would be a highly effective means of discharging large volumes of water. A continuous supply of cold clean water may enhance biodiversity in the stream and could be used to supplement existing groundwater releases to surface water. The discharge would need to be carefully studied to ensure that all factors are considered and that adverse effects such as scouring, sedimentation in the bay, and habitat loss do not occur. The discharge point to surface water would also need to be carefully evaluated to ensure that it does not infiltrate and impact local public water supplies.

Discharge to the Bay/Ocean would unnecessarily remove fresh water from the Long Island Aquifer and would promote salt water intrusion for those water districts in close proximity to the bay/ocean (e.g., Massapequa Water District).

Implementability

Although long distances are involved (i.e., 2 to 8 miles), discharge should be implementable. Piping would run along existing roadways and stream beds to the extent practical, but would still involve disruptive activities in densely populated commercial, residential, and wetland areas. In the past, this type of disruption has not been well received by the public, which has significantly delayed similar construction projects (e.g., GM-38 and RW-21 Treatment Systems).

Cost

Piping costs are approximately $1.0 million to $1.5 million per mile (higher along roadways with utilities and lower along stream beds) and total approximately $3.0 million to $10.0 million. Routine monitoring costs, consisting primarily of monthly VOC analysis and reporting, would be approximately $50,000 per year.

4.5 SANITARY SYSTEM

Sanitary sewer discharge would consist of a combination of a pipe/sewer line to transport water to a discharge point in the existing sanitary system capable of handling the flow rate. Sanitary system discharge may be considered primarily for those systems with anticipated short term operation. Due to attenuation and treatment in the sanitary system, pretreatment requirements would likely be less stringent. (e.g., GAC polishing may not be required).

Effectiveness

Discharge to the sanitary sewer system would be an effective means of discharging water. The discharge water would be aerated and additional VOCs would be removed at the Sanitary Wastewater Treatment Plant. The water would enter the Ocean through the sanitary system discharge.

Discharge to the Ocean would unnecessarily remove fresh water from the Long Island Aquifer and would promote salt water intrusion for those water districts in close proximity to the bay/ocean (e.g., Massapequa Water District).

Implementability

Discharging large volumes of water to the sanitary system should be implementable. The capacity of the sanitary sewer piping and lift stations would require a detailed evaluation to confirm that ability to handle the flow, and upgrades may be required. The local sanitary sewer system (Cedar Creek) operates at an average of approximately 58 MGD, below its permit limit of approximately 70 or 72 MGD.

This discharge of relatively clean water may adversely effect the operation of the sanitary system, and may require some upgrades or other modifications at the facility. The discharge rate may need to be reduced during daily peak system flow to prevent system overflows. The County and State would need to concur with use.

Cost

Construction costs are dependent on the distance to transport the water for reuse. Assuming that a primary sewer line is available along Stewart Avenue, approximately 0.25 mile east of BWD Plant 6, construction costs would be expected to total approximately $0.5 million to $1.0 million. Operating costs would be very high, approximately $0.6 million to $1.2 million per year for sewage fees. Routine monitoring costs, consisting primarily of monthly VOC analysis and reporting, would be approximately $50,000 per year.

4.6 PUBLIC WATER SUPPLY

Public water supply would consist of maximizing the use of extracted and treated groundwater for general consumption by the community. As discussed above, the water treatment technologies between remediation systems and public water supply treatment systems is very similar. The primary difference is that the public water supply treatment systems are also protected against bacteria. Unlike the other discharge options, use of the public water supply is driven by demand, which varies throughout the day, week, and year. Water districts manage this variability through the operation of multiple wells and storage. The preference would be to operate BWD Well 6-2 on a continuous basis and use the majority, if not all, of the treated water within the distribution system. This operation would also save unaffected groundwater for future generations.

Effectiveness

The public water supplies can effectively use treated groundwater. The water districts have demonstrated the ability to effectively operate VOC treatment facilities in the area for over twenty years. This effectiveness results from the reliability of the technology and controls and experience of the operators and regulators.

Implementability

The implementability of recycle/reuse is dependent on the availability of users, the distance to the user, and the ability for the user to handle high volumes of water on a continuous basis. Since existing infrastructure is used, this option would have minimal impact on the community and can be implemented quickly.

Cost

Costs are dependent on the distance to transport the water for reuse. For BWD Plant 6, where existing infrastructure can be used, capital costs are very low. Since most of the routine monitoring costs would be addressed with operations, additional operating costs would be low.

5.0 EVALUATION SUMMARY

The Navy evaluated six use/disposal options for the treated water from BWD Well 6-2. This evaluation consisted of the primary criteria of effectiveness, implementability, and cost. In addition, other factors were considered, including disruptions to the community, impacts on the aquifer, and long-term sustainability. The evaluation and ranking of each of the discharge options are summarized in Table 1.

Table 1 – Evaluation Summary

Discharge Option	Effectiveness	Implementability	Cost	Disruption to the Community	Impact on the Aquifer	Long-Term Sustainability	Overall Ranking
1. Recharge Basins	High	High	Low	Medium	Medium	Medium	2
2. Dry Wells and Leach Fields	High	Medium	Medium	Medium	Medium	Medium	3
3. Injection Wells	Medium	Medium	High	Medium	Medium	Medium	4
4. Surface Water Discharge	High	Low	Medium	High	High	Low	5
5. Sanitary Sewer	Medium	Medium	High	Medium	High	Low	6
6. Public Water Supply	High	High	Low	Low	Low	High	1

Ranking from 1 to 6, where 1 is the best and 6 is the worst.

High Medium Low

6.0 CONCLUSIONS AND RECOMMENDATIONS

The general conclusions and recommendations developed in this technical memorandum are as follows.

1. The sustained operation of BWD Well 6-2 is an important part of an overall program to manage the RE-108 Hotspot and could be used to capture up to 40 percent of the RE-108 Hotspot groundwater. Based on its mid-plume location, sustained groundwater extraction at this location would significantly accelerate cleanup of the Hotspot and the overall groundwater plume.
2. The water districts have demonstrated the ability to effectively operate VOC treatment facilities in the area for over twenty years.
3. Public water supply systems and groundwater remediation systems contain many common features, with only one significant difference – the use of sodium hypochlorite to control bacterial.
4. The treatment requirement for VOCs at public water supplies are the same as the treatment requirements for VOCs at remediation systems – to achieve MCLs, and the treatment goal is typically 1/10 of MCLs.
5. Since existing infrastructure is used, use of BWD Plant 6 as a remediation system would have minimal impact on the community, can be implemented quickly, and costs are low.
6. There are no technical disadvantages identified with using BWD Plant 6 as a dual purpose remediation and public water supply well.
7. Sustained operation of BWD Well 6-2 as a remediation well would reduce potential impacts to downgradient water suppliers and therefore, the need for additional wellhead treatment would lessen.